

Electronic Supporting Materials

An autocatalytic CO hydrogenation approach for the fabrication of stable
Fe-based superhydrophobic surfaces

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Materials and methods

The hydrothermal reaction mixtures containing iron source ($\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$ / $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$), pore expanding agent ($\text{C}_6\text{H}_{12}\text{N}_4$), solvent (H_2O) were obtained by mixing them in proportion and stirring to dissolve completely. The Fe foam substrate (100 ppi) purchased from Kunshan Tengerhui Electronic Technology Co. Ltd for the structured Fe-based sample was pretreated in an ultrasonic cleaner by acetone, 1M HCl and deionized water for 10 min to remove grease and rust. The hydrothermal reactor made in Anhui Kemi Machinery Technology Co., Ltd was placed in an oven for 6 h at 160 °C, resulting in a rough surface with the micro- and nano- hierarchical structure. Detailed preparation process can be found in our published paper.¹ Then the hydrothermal products were put in a fixed bed purged of hydrogen for 4 h at 400 °C under atmospheric pressure. Subsequently, the CO hydrogenation reaction condition was set at 300 °C, 2.0 MPa, 1500 h⁻¹ in a flow of $\text{H}_2/\text{CO}=2$ for 96 h. Finally, the structured Fe-based superhydrophobic surface with a rough structure filled with low surface energy was synthesized. The powder Fe-based sample was synthesized by the same approach in the absence of Fe foam.

The above-mentioned autocatalytic CO hydrogenation reaction was performed in a fixed bed reactor at high pressure and high temperature, which was the typical reaction conditions. Simultaneously, the autocatalytic CO hydrogenation reaction could be also carried out in a tubular furnace at atmospheric pressure. The aforementioned hydrothermal products were put in a tubular furnace purged of syngas for 4 h at 400 °C (or 12 h at 300 °C) under atmospheric pressure. And the superhydrophobic surfaces can

be achieved successfully from this approach.

X-ray diffraction (XRD) were measured on a DX2700B diffractometer with Cu K α radiation operated at 30 mA and 40 kV. Fourier Transform Infrared spectroscopy (FT-IR) was performed on TENSOR27 (Germany) to analyze chemical composition. Field emission scanning electron microscopy (FESEM) images were obtained on a Tescan Mira 3 microscope. The water contact angles were characterized by an optical contact angle meter (JC2000C1, Shanghai) at ambient temperature. The powder Fe-based samples were put on a glass slide, another slide was gently pressed against it to obtain a flat surface. No more treatments were required for the structured Fe-based sample before contact angle measurement. A water droplet with volume of 4 μ L was dropped onto the sample surface. The static contact angle was calculated based on the results of three different places of the same sample.

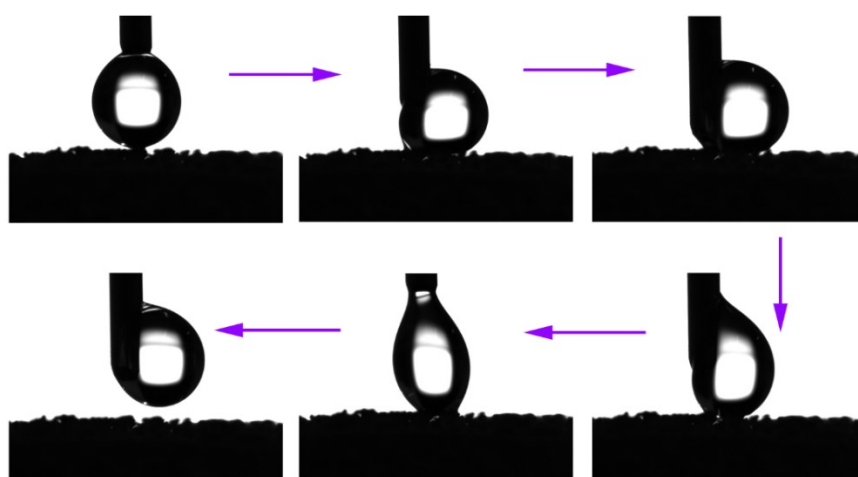


Fig. S1. Dynamic process of a water droplet adhesion, squeeze, deformation and departure on the structured Fe-based sample.

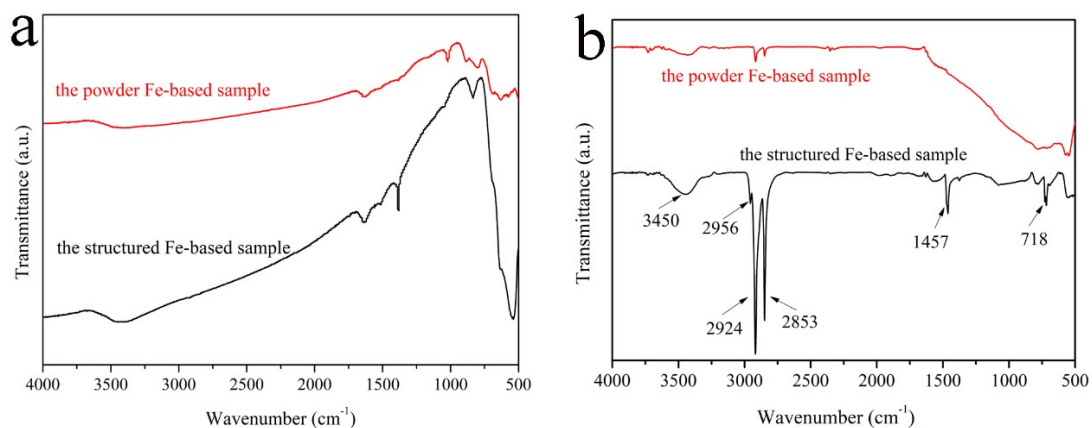


Fig. S2. FT-IR spectra of the structured and the powder Fe-based samples. (a) Before the CO hydrogenation reaction; (b) After the CO hydrogenation reaction.

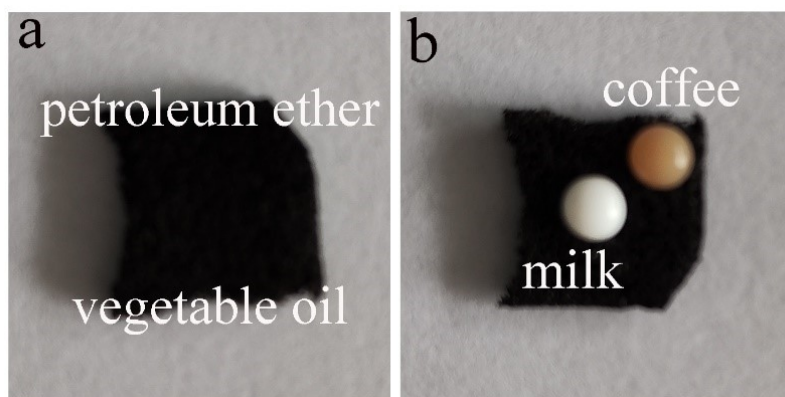


Fig. S3. The optical photographs of the structured Fe-based sample. (a) The wetting behavior of organic liquids; (b) The wetting behavior of aqueous liquids.

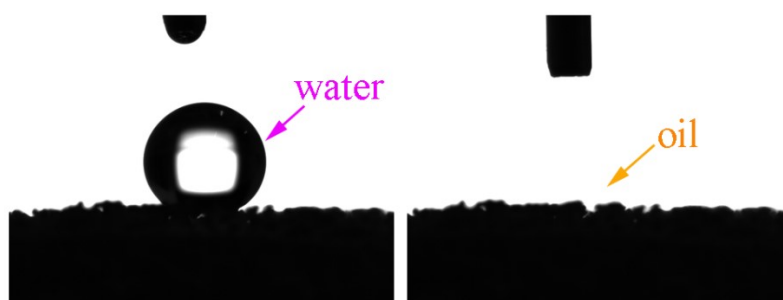


Fig. S4. Water contact angle and oil contact angle of the structure Fe-based sample.

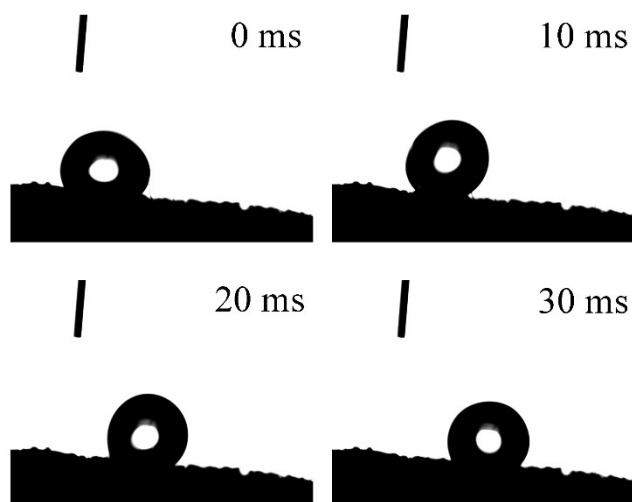


Fig. S5. The dynamic sliding photographs of water droplet on the structured Fe-based sample.

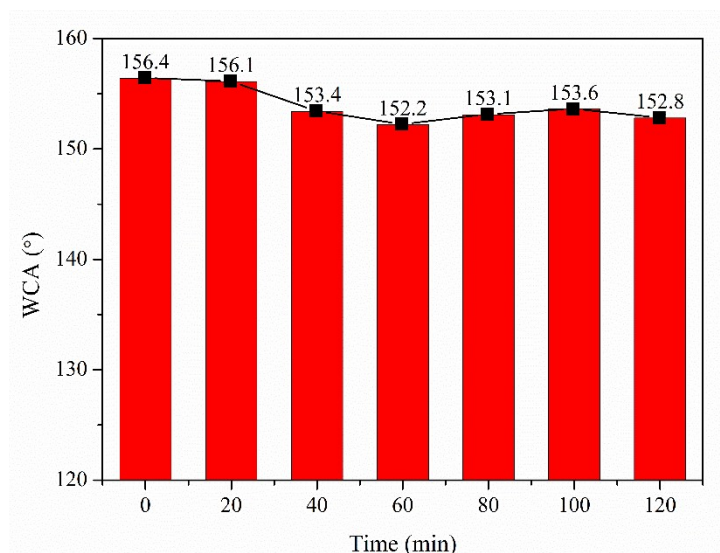


Fig. S6. The change of WCA on the structured Fe-based sample with different treatment time in boiling water.

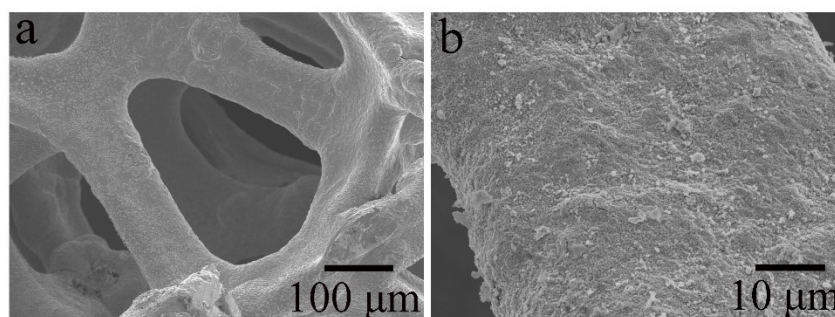


Fig. S7. FESEM images of (a) the virgin Fe foam substrate and (b) the structured Fe-based sample after autocatalytic CO hydrogenation reaction.